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Role of Sticky Bone in Regeneration of Bony Defects in Periodontitis: A Clinical Case Series

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ABSTRACT

Periodontitis leads to progressive destruction of periodontal structures, often necessitating regenerative interventions. Injectable Platelet-Rich Fibrin (i-PRF), combined with bone grafts to form "sticky bone", is emerging as a promising regenerative approach. Sticky bone was generated by preparing i-PRF through the centrifugation of 10 mL of autologous venous blood and mixing it with demineralized bone matrix (Osseograft) to obtain a moldable and cohesive graft complex. This fibrin matrix not only secured the graft particles but also provided a biologically active framework that facilitated cell migration, proliferation, and neovascularisation. Additionally, the gradual release of growth factors from i-PRF promotes enhanced angiogenesis, soft tissue repair, and bone regeneration. This case series reports on three patients with intrabony defects and furcation involvement who were treated using i-PRF-based sticky bone. The clinical and radiographic outcomes were assessed at follow-up visits. All cases demonstrated a significant reduction in probing depth, along with radiographic evidence of bone fill. Healing was uneventful, and results remained stable over time. Sticky bone is a promising, autologous biomaterial that supports effective and predictable periodontal regeneration.

1. Introduction

Periodontitis is a highly prevalent disease worldwide.[1] It is expected that there will be a substantial increase in the number of individuals with periodontitis in the coming years.[2] Periodontitis begins as gingival inflammation in response to dysbiotic bacterial plaque.[3] Persistent inflammation led to alveolar bone resorption and ultimately tooth loss.[4] Periodontal therapy aims to remove the bacterial plaque and control the host inflammation.[5] Eradication of deep pockets (> 6mm) and furcation invasions are regarded as the clinical endpoints of a successful periodontal treatment. (Perio insight 5-autumn 2017, EFP). Similarly, treatment of intra-bony defects should demonstrate periodontal regeneration, resulting in a reduction in probing depth, an increase in clinical attachment, and radiographic evidence of bone fill.[6] The regeneration of bone defects resulting from periodontitis consistently creates a challenge for clinicians. Due to their excellent osteogenic potential, autogenous bone grafts remain widely recognized as the gold standard in bone regeneration.[7] Allografts are regarded as a viable alternative to autologous bone, offering advantages such as being readily available for use, a favourable safety profile, availability in various dimensions, and the elimination of donor site morbidity.[8] Grafts taken from different species and bone substitutes like alloplastic materials have also been tried with varying degrees of success.[9] Over the past three decades, enamel matrix derivatives (EMD) and other biological agents have gained significant popularity due to their superior clinical outcomes.[10]

Autologous Blood Concentrates for Periodontal Regeneration

The application of platelet concentrates has been a significant revolution in the fields of medicine and dentistry, particularly for wound healing and tissue regeneration. Platelet-rich plasma (PRP) is a first-generation platelet concentrate. The significant advantage of PRP is its fluid consistency, which allows it to be mixed with various graft materials or injected into joint spaces. However, the presence of anticoagulants, inability to clot, and rapid release of growth factors minimize its use as a healing and regenerative material. Platelet-rich fibrin (PRF), introduced by Choukroun et al, is a second-generation platelet concentrate that contains platelets and growth factors within a fibrin matrix.[11] The clinical utility of PRF is versatile than PRP because of its ease of preparation and lack of biochemical handling of blood. PRF has a flexible fibrin network that is rich in leukocytes, growth factors, and cytokines. PRF is regarded as a highly promising biomaterial for periodontal regeneration in periodontal intra-bony defects and furcation.[12, 13] The Low-Speed Centrifugation Concept (LSCC) was a significant breakthrough in optimizing PRF preparation. This led to the formation of a non-clotted, liquid form of PRF, later termed Injectable Platelet-Rich Fibrin (i-PRF).[14, 15] This biomaterial combines the advantages of both PRP and PRF. In 2017, R.J. Miron proposed a low-speed protocol for i-PRF preparation, in which blood collected in plastic tubes was centrifuged at 700 rpm for 3 minutes, and the force was then increased to 40 g. The hydrophobic surface of plastic tubes and low centrifugation speeds do not effectively activate the

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coagulation process. This resulted in a liquid form of PRF that contains fibrinogen, which slowly polymerizes to form fibrin.[16] So there is a sufficient working time before formation of the fibrin clot during which the clinician can inject this liquid or mix this material with the graft. Sticky bone is an innovative regenerative biomaterial formed by combining particulate bone graft material with PRF or i-PRF, offering excellent properties for tissue regeneration.[17] When bone graft is mixed with i-PRF, it forms a cohesive, adaptable, workable mass which can be placed and contoured in intra-bony defects. This case series presents the successful management of two intrabony defects and one furcation involvement using sticky bone, all performed at the Department of Periodontics, Government Dental College, Kottayam. In each case, autologous injectable platelet-rich fibrin (i-PRF) was prepared by centrifuging blood at 700 RPM for 3 minutes. The collected i-PRF was then mixed with demineralized bone matrix (Osseograft) in a sterile dappen dish to form sticky bone.

2. Case Presentation

Case 1

A 52-year-old female reported to the Department of Periodontics with a chief complaint of pain and bleeding from the gums in the lower right posterior region for one month. Careful clinical examination revealed a deep periodontal pocket of 11 mm with pus discharge distal to tooth 43. A thorough medical history was taken, and blood investigations were done to rule out systemic diseases. Radiographic evaluation confirmed a vertical bone defect on the distal aspect of tooth 43, with severe bone loss extending to the apical third of the root. Regenerative periodontal therapy was planned. Instructions for meticulous plaque control were given. Initial professional mechanical plaque removal done. A papilla-preservation flap design was employed under local anaesthesia, following informed consent. A full-thickness mucoperiosteal flap was elevated, and the defect was thoroughly debrided. The sticky bone was prepared according to the protocol mentioned above and used to fill the intra-bony defects. The site was closed with interrupted 5-0 Vicryl sutures (Fig. 1). Postoperative instructions were given. Sutures were removed on the seventh day post-surgery. Patient was recalled at 3 months and 6 months. At the 6-month follow-up, clinical examination revealed a reduced periodontal probing depth of 3 mm distal to tooth 43. A follow-up RVG was taken to evaluate the defect, which showed that significant bone formation had occurred, extending up to the middle third of the tooth (Fig. 2)

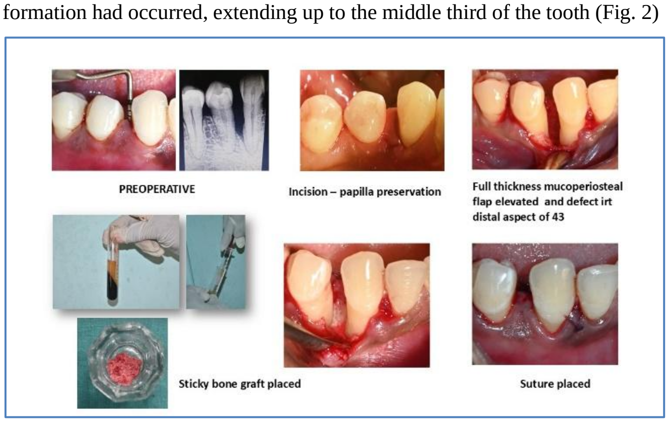

Fig. 1. Preoperative and surgical photographs of case I.

Fig. 2. Six months followup of case I.

Case 2

A 48-year-old healthy male came with a complaint of bleeding from the gums on the upper left back teeth. He had no significant medical history. A clinically periodontal pocket of 12 mm depth was noted on the distopalatal aspect of tooth 26. Radiographic evaluation revealed a deep intrabony defect on the distal aspect of tooth 26. Regenerative periodontal therapy was carried out after pre-surgical preparation. Surgical procedure was done following administration of local anaesthesia; an incision was made and a full-thickness mucoperiosteal flap was elevated. The defect was curetted well, and a sticky bone graft was meticulously placed to fill over the 2-wall defect. The flap was repositioned and secured with sutures. The patient's healing was uneventful over a period of 6 months. Re-evaluation after 6 months revealed a reduced periodontal probing depth of 3 mm distal to tooth 26, and RVG showed significant bone formation extending up to the middle third of the root (Fig. 3).

Fig. 3. Preoperative and postoperative photographs of case II.

Case 3

A 55-year-old female came with a chief complaint of bad breath and pain in the lower left gum region. There was no relevant medical history, and all routine blood investigation parameters were within normal limits. Clinical examination revealed a periodontal pocket of 7mm and Glickman's grade I furcation involvement in relation to 36. RVG revealed furcation radiolucency and an intrabony defect in relation to 36. Pre-surgical preparation was carried out. The surgical procedure began with an internal bevel incision and the elevation of a full-thickness mucoperiosteal flap, which exposed a crater-like defect on the buccal aspect of the tooth. After thorough debridement, the area was filled with sticky bone prepared as described above. It was contoured and adapted to the defect site to facilitate bone regeneration. Flaps repositioned, sutured with 3-0 silk, and primary closure is achieved (Fig. 4). Postoperative instructions given. She was put on a recall schedule. Clinical and radiographic examinations were done at 4, 6, and 12 months. There was a dramatic bone fill at the furcation, and the patient maintained the results 2 years postoperatively (Fig. 5).

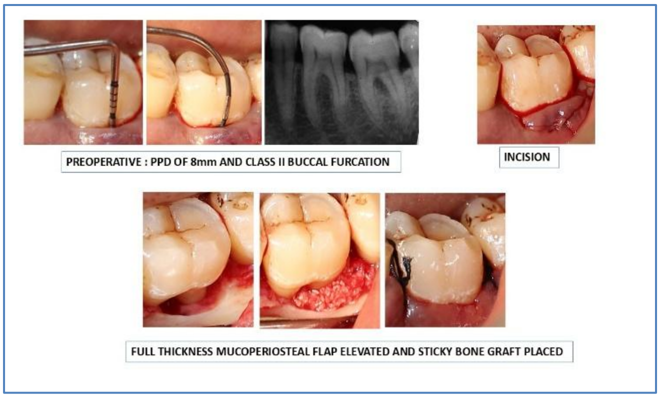

Fig. 4. Preoperative and surgical photographs of case III.

Fig. 5. 2-year followup of case III.

3. Discussion

The use of autologous platelet concentrates is the simplest and cost-effective way to achieve regeneration in dentistry. Alpha granules of platelets are known to release high quantities of growth factors. They stimulate cell proliferation, matrix remodelling, and angiogenesis, which ultimately accelerate wound healing and tissue regeneration. The release of growth factors from PRP is very rapid, whereas the release may last approximately 10 days in the case of PRF and advanced forms of PRF.[18] Sticky bone is regarded as a next-generation regenerative material that merges the biological advantages of growth factors embedded in a fibrin mesh with enhanced mechanical and physical properties provided by the structural support of bone grafts. Sticky bone was first introduced in dentistry by Sohn et al. in 2010. The same authors used a sticky bone made of autologous concentrated growth factor (CGF), bone graft, and CGF-enriched membrane for ridge augmentation in implant dentistry.[19] i-PRF was introduced as an advanced form of PRF, created by modifying the centrifugation protocol specifically, by reducing the centrifugation speed to 700 rotations per minute (RPM) and the relative centrifugal force to 40 g. This method separates the blood into two compartments. The superficial liquid PRF can be aspirated with a syringe, and it remains in a liquid injectable form for approximately 15-20 minutes before slowly converting to fibrin.[15] During this transition phase, the clinician can effectively use this biomaterial. To optimize the release of growth factors and increase the working time of i-PRF, different centrifugation protocols and technical modifications (hydrophobic plastic PET tubes) were later introduced. A 15 Horizontal centrifugation system produces a superior quality of i-PRF compared to the conventional fixed-angle type.[15] This is directly related to the inclusion of 3 times higher platelets and leukocytes in i-PRF, with relatively less trauma to the cells, preserving their integrity. Two types of i-PRF were recognized: yellow and red i-PRF, depending on the area of collection. Yellow i-PRF exhibits superior mechanical properties and enhances calcification and bone formation compared to red type. The red i-PRF has a higher concentration of erythrocytes, platelets, and leukocytes, and consequently, it has a high concentration of growth factors. The red i-PRF exhibits superior properties in terms of cell proliferation, migration, and differentiation.[20] The biological properties of i-PRF that promote healing and regeneration are outlined below. In vitro studies have demonstrated that neovascularisation and angiogenesis occur when i-PRF is used, which is likely related to the prolonged release of growth factors.[21] The systematic review conducted by Strauss et al highlighted that there is enhanced proliferation, migration, adhesion, and differentiation on a variety of cell types in response to i-PRF application.[22] PRF contains extracellular glycoproteins like fibronectin, which may accelerate adhesion of periodontal ligament cells on the root surface, enhancing new attachment. I-PRF is known to possess potent anti-inflammatory activity, and in vitro studies show a shift in macrophage phenotype from pro-inflammatory M1 to pro-resolution M2.[23] This phenotype switching may be directly linked to a reduction in postoperative pain, inflammation, and oedema. In vitro studies demonstrate accelerated proliferation and migration of osteoblastic cell lines, as well as increased mineral nodule formation, as evidenced by increased alkaline phosphatase activity.[24] i-PRF positively influences the early stage of osteogenesis by increasing the OPG production and osteoblastic differentiation.[25] Autologous platelet derivatives PRF and i-PRF possess antimicrobial activity against black pigmented anaerobes, Aggregatibacter actinomycetemcomitans, which is comparable to metronidazole.[26] When i-PRF is combined with various bone graft materials in the form of sticky bone, it significantly improves the characteristics of human osteoblasts, enhances the mechanical properties, and osteogenic potential.[27] Rupawala etal used sticky bone as a novel autologous biomaterial for socket healing following mandibular third molar extraction. The study's results showed enhanced gingival healing, decreased pain and postoperative swelling, and rapid bone formation with superior quality in test sites where sticky bones were used.[28] The first published systematic review on the use of sticky bone in the regeneration of bone defects, conducted by Sareen et al. in 2024, concluded that sticky bone is a promising material for regenerating various types of alveolar bone defects, with improved clinical and radiographic results.[17] In a randomized controlled trial by Salama et al., which evaluated the efficacy of Sticky Bone with repeated application of i-PRF at 14 and 28 weeks postoperatively for the management of intra-bony defects, improved clinical and radiographic outcomes were shown.[29] A randomized controlled trial conducted by Ghoderao et al. compared sticky bone with Concentrated Growth Factor. The test group with sticky bone showed improved clinical and radiographic outcomes.[30] The reported literature evidence demonstrates that sticky bones have the potential to improve wound healing and bone regeneration. This case series highlights the regenerative potential of i-PRF and bone marrow concentrate. The present case series highlights the regenerative benefits of using sticky bone in managing periodontal defects. By combining the biological activity of injectable platelet-rich fibrin with the stability of bone grafts, sticky bone provides a grafting material that supports predictable soft tissue healing and accelerated bone formation. These findings are in agreement with previous studies that have reported enhanced clinical and radiographic outcomes with sticky bone compared to conventional approaches. The autologous origin, cost-effectiveness, and ease of preparation further strengthen its appeal as a regenerative option in routine practice. Although larger randomized trials are required to validate these observations, the evidence to date suggests that sticky bone is a promising biomaterial with significant potential for regenerating periodontal and alveolar bone.

4. Conclusion

Sticky bone is a groundbreaking biomaterial that leverages concepts in tissue engineering. A variety of combinations of sticky bone can be made by changing the platelet concentrate and bone grafts. Sticky bone accelerates bone formation and significantly improves bone quality. Clinicians can surely rely on this material for improved clinical outcomes.

Conflict of Interest

The authors declared that there is no conflict of interest.

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